Final Report

Reimbursement for Direct Costs of Unimpaired Flows

Submitted by:
Great Northern Corp.
PO Box 20
Weed, Ca 96097

Submitted to:
US Fish and Wildlife Service
1829 So. Oregon St.
Yreka, CA 96097

December 23, 2002

Cooperative Agreement # 14-48-11333-8-J068
Project Number 98-HP-04

Abstract:

In 1993 the Shasta CRMP initiated a voluntary program of spring and early summer pulsed flows in the Shasta River, primarily to improve the survival of fall Chinook salmon, then at critically low levels. In 1998 the USFWS through the Klamath River Basin Fisheries Task Force provided some limited funds to help meet costs directly associated with that effort in order to reduce hurdles to its continued implementation. The Shasta CRMP had envisioned that the Pulsed Flows would be utilized as a stop-gap measure to compensate for high summer water temperatures and low levels of dissolved oxygen, with improvements in water quality seen as the needed permanent change that would make the pulsed flows unnecessary in the future.

Description of Study Area:

The Shasta River located in Siskiyou County, California flows out of the Eddy mountains and Mount Shasta northward into the Klamath River approximately twenty miles south of the Oregon border, and 175 miles upstream form the Pacific Ocean. The Shasta Basin area is approximately 800 square miles with a mean annual unimpaired runoff of approximately 171,000 acre-feet. The mainstem Shasta River is approximately 60 miles long, with a permanent winter storage reservoir (Lake Shastina) at river mile 40. That reservoir limits the upstream range of salmon, and generally has no instream flow release other than to meet prior water rights immediately downstream of the reservoir.

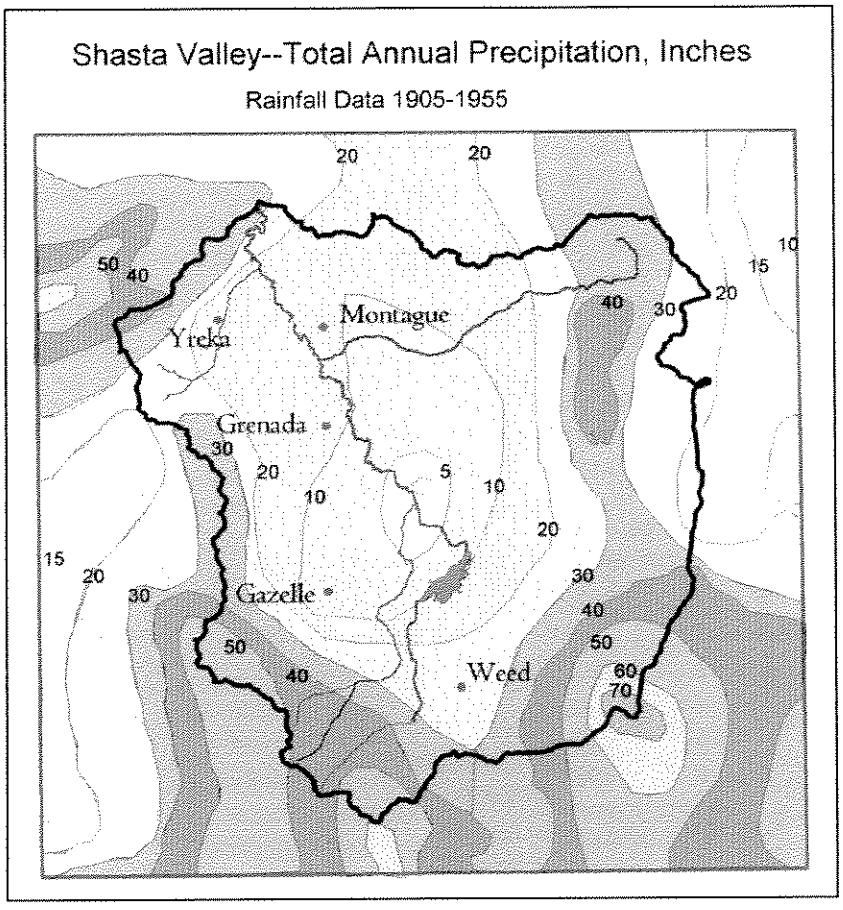
Key features of the Shasta River include significant spring flow in the area below Lake Shastina, increased water development to provide water for irrigation in the middle portions of the Shasta Valley, river inflows and outflows of variable quantity and quality, both natural and irrigation derived, and a range of riparian conditions throughout the system.

Elevated water temperature and reduced dissolved oxygen levels have placed Shasta River on the California 303 (d) list of impaired waterbodies.

Anadromous fish using the system include fall Chinook salmon (Onchorynchus tshawytscha), coho salmon (Onchorynchus kisutch), and steelhead trout (Onchorynchus mykiss).

The climate of the Shasta Valley is extremely dry, with total precipitation ranging between 5 and 70 inches per year, depending on location. Temperatures on the valley floor range from below zero to over 100 degrees F.

Historically the Shasta River was the most productive salmon-bearing stream in the entire Klamath--Trinity Basin. Counts of Fall Chinook spawner returns begun in 1930 (after runs were described as insignificant in comparisons to their previous numbers) were as high as 81,000. The Shasta also produced high numbers of steelhead, and unknown numbers of Spring Chinook and coho. Spring Chinook are no longer found in the system.



Since the 1930's, Fall Chinook salmon numbers have dropped as low as 530 (in 1992), leading to concerns of extinction of the run, and precipitating the formation of the Shasta CRMP. By 1995, numbers had rebounded to as high as 13,000 demonstrating the continued resiliency of the Shasta system, and possible combined beneficial effects of restoration measures (including pulsed flows), and improved ocean conditions.

Introduction:

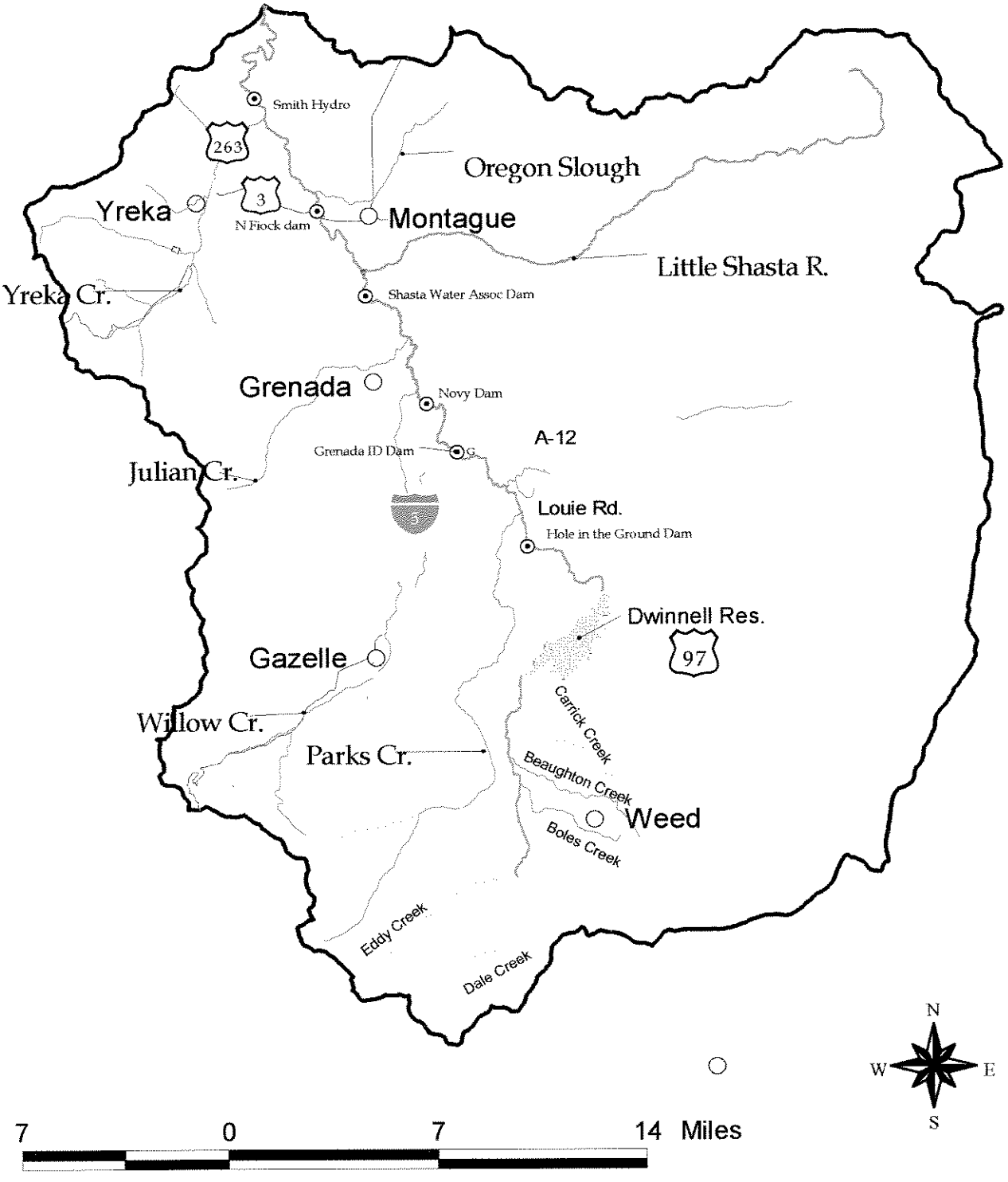
Substantial restoration work has been ongoing throughout the Shasta Watershed since 1989, with the unimpaired flows described in this report constituting a small portion of that overall effort.

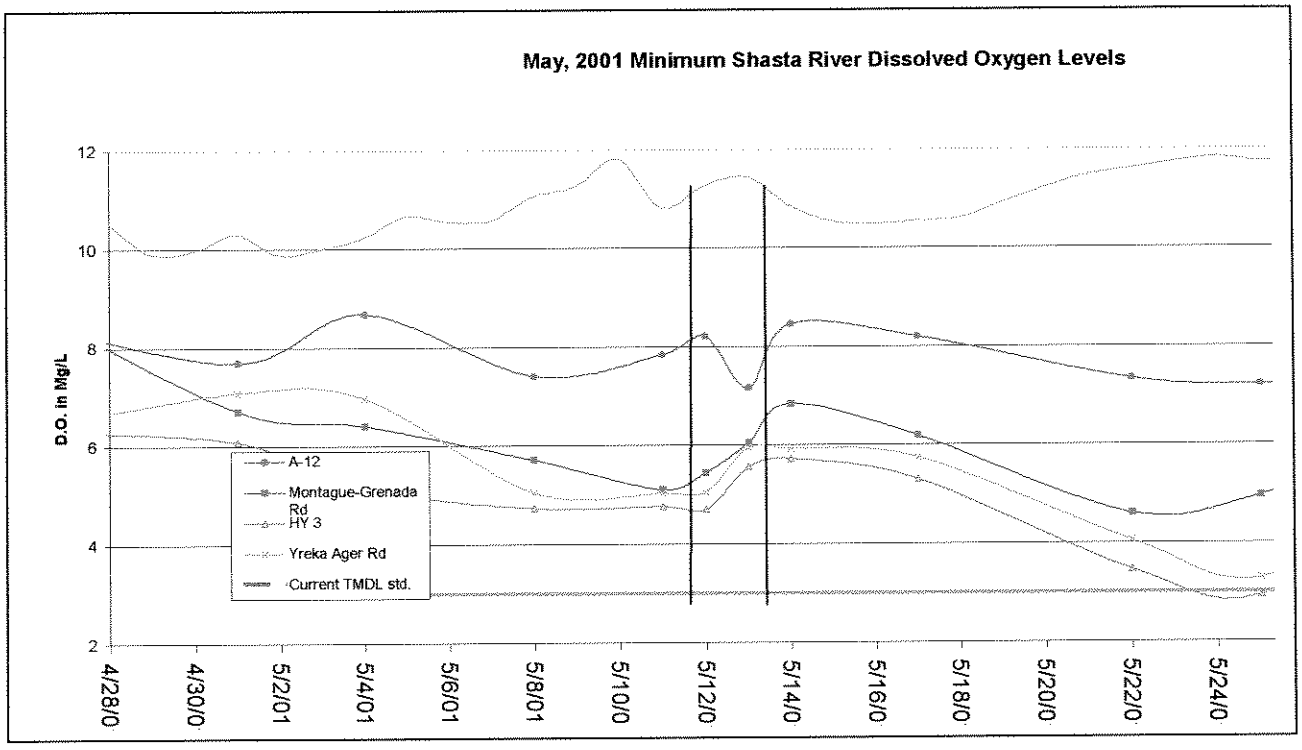
The Shasta CRMP had envisioned the unimpaired flows to be utilized as a stop-gap measure to compensate for high water temperatures and low levels of dissolved oxygen that were otherwise apparently limiting production of fall Chinook salmon. Improvements in water quality were seen as the targeted permanent measure that would eventually make the unimpaired flows unnecessary.

More recently, concerns for coho and steelhead have contributed to the hope that the removal of the flashboard dams will also provide an opportunity for juvenile fish of those two species to move upstream to areas where cold water will be reliably available through the summer. Except during the unimpaired flows, no provision is in place for the upstream migration of juvenile salmonids. Unfortunately, no method had been devised to monitor the effectiveness of this hoped-for effect.

The Klamath River Basin Fishery Task Force has provided limited funding through this grant in order help meet the direct costs associated with the continued implementation of the unimpaired flows for

Mainstem Shasta Flashboard Dams





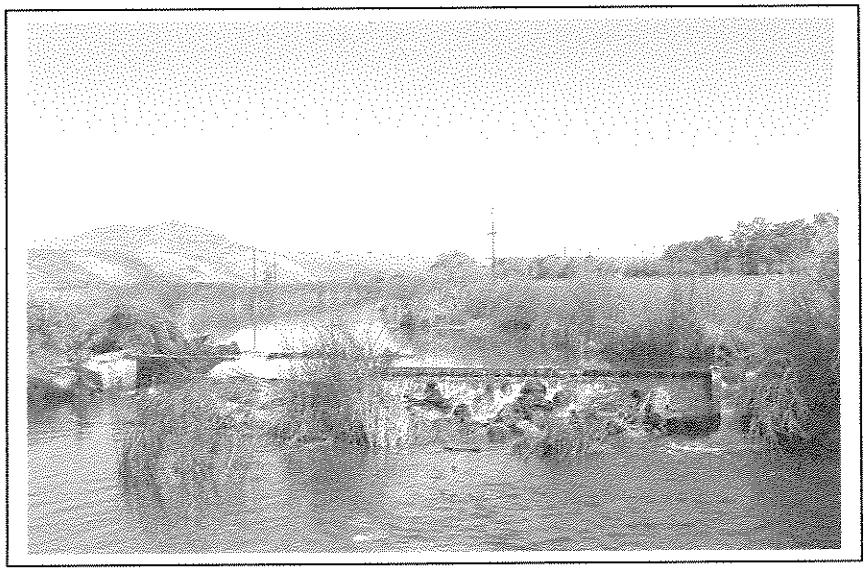
Pre-dawn dissolved oxygen levels in Shasta River in 2001, with timing of unimpaired flow delineated.

one year in the Shasta River. Because instream flow conditions are quite variable from year to year, the bulk of the money was rolled over until conditions were deemed appropriate for a pulsed flow.

Methods and Materials:

The planning process for unimpaired flows generally begins in January or early February, when the Shasta River Coordinated Resources Management and Planning group (CRMP) discusses whether or not it wants to recommend the need for an unimpaired flow during the upcoming summer.

Since the effort is voluntary, this recommendation has become largely routine, but it does provide a forum to discuss past efforts and their possible effects, and revisit the overall



Diversion dam downstream of the HY 3 bridge over the Shasta River. Flashboard section is to left, area repaired following flood damage to right.

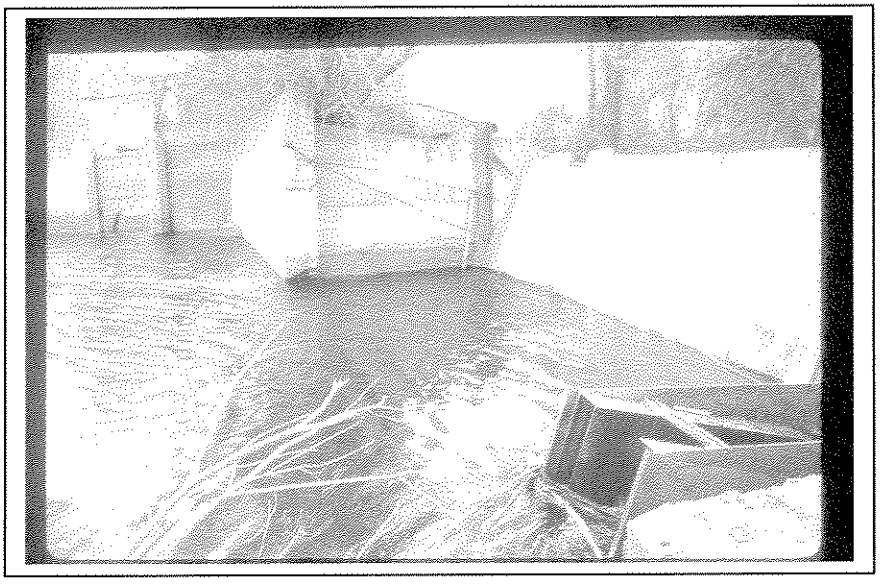
goal of water quality improvements to eliminate the need for unimpaired flows in the future. It is also an opportunity to address any past problems, and consider ways to improve the effectiveness of the overall effort, or seek ways to minimize any negative impacts.

Once a recommendation to proceed has been secured, the CRMP Coordinator requests time on the agendas of the three irrigation districts (Montague Irrigation District, Shasta Water Association, and Grenada Irrigation District, the three organizations who utilize water directly from the Shasta River) who are needed to make the effort successful.

Ideally the CRMP Coordinator will make an informational presentation at their February meetings, covering much of the same information discussed the CRMP meeting described above, then make arrangements to return to the next monthly meeting to request irrigation district board action on whether or not to support the effort. The district boards can then discuss this among themselves, and also hear from their members over the course of the next month.

The next month, the CRMP Coordinator will again attend the irrigation district meetings, briefly summarize the process, and answer any additional questions. Following that the board of directors of each can vote whether or not to participate.

It is not uncommon for any of these boards to have to either cancel meetings or upon arrival, discover that a quorum is not present, making it necessary to repeat the process at the next meeting the following month. This uncertainty, coupled with the requirement that the districts adhere to making decisions at public meetings is the primary reason the process must start so early in the year.

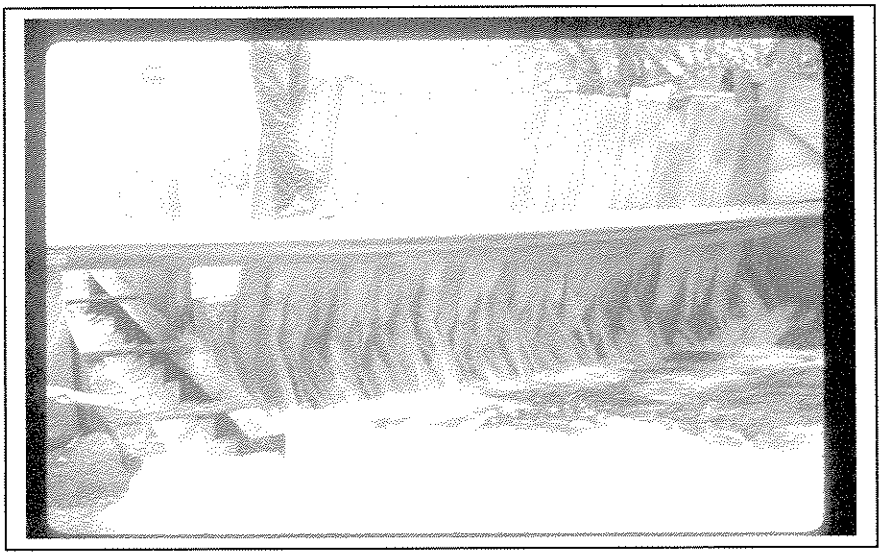


Upstream face of Grenada Irrigation District and Huesman Ditch diversion dam.

Unfortunately, it is often impossible to even guess in February or even March what the water year will look like, and/or predict how desperate each district may be for water--the Montague Irrigation District because all of its water must be captured and stored during the winter and spring, and the total amount of snowpack and nature of the melt-off can' t be known until later in the year, and the because the junior nature of its water right means that in a poor water year their ability to withdraw water can be severely constrained, making unimpaired flow shut-downs politically very difficult. The Shasta Water Association is relatively secure in its ability to have water available each year, but if the weather at the scheduled time of the unimpaired flow is hot and windy they are likely to be behind in providing water to the individual ranches they serve in a timely fashion, and a two day shutdown will only make things worse, again making an advance decision politically risky.

Beyond that, for all three districts events entirely unrelated to this specific effort can create a climate where it is temporarily politically impossible to take any action to benefit fish.

If the Shasta Water Association is able to provide at least conditional agreement to participate, then the process has the potential to yield beneficial results, although its apparent effectiveness is far greater with the involvement of the other two districts.



Downstream face of Grenada Irrigation District and Huesman Ditch diversion dam.

At that point, the CRMP Coordinator can start making contact with several individual irrigators and associations of irrigators who also have or share flashboard dams. Most notably this will include the Huesman Ditch Association, the Novy Ranch, the Rice Ranch, the Kuck Ranch, the Mariani Ranch, the N. Fiock Ranch, the E.C. Fiock Ranch, the Himmel Ranch and the Spearin Ranch. The entire process is then discussed again with each individual user, and hopefully agreement secured to proceed. Since these users and associations can legally make decisions at the moment, contact with them can be delayed until April, when the irrigation district's decisions are generally known. While a decision to participate can generally be made fairly quickly, it often takes a great deal of time traveling from ranch to ranch to meet with them and discuss things, but this seems to be the most effective way to proceed successfully.

While the amount of water these irrigators collectively use is much less than that of the irrigation districts, it is still necessary to remove their shared flashboard dams in order to provide a maximum of free passage. Most of these water users are in a far more flexible position with regards to meeting their irrigation needs, and they can generally flex their schedules with minimal impact on crop growth except in the worst of years when hot and windy conditions will affect them also.

As May begins, final planning must be done. If there are late rains or a substantial snow pack, it is possible that either no one will be irrigating, or that there will be so much water in the river that no one has even had cause to even install their flashboard dams, in which case the May unimpaired flow may be canceled on the presumption that it can have no additional beneficial effect. As is more often the case, all dams have been installed since April 1, and flows in the river are substantially below what would be naturally present.

Over the years, two basic approaches have been tested--either picking a day on the calendar on which to begin, or trying to wait and make a decision at the last minute. The last minute means that water temperatures are expected to exceed about 74 degrees F, where stress and mortality is likely to become significant.

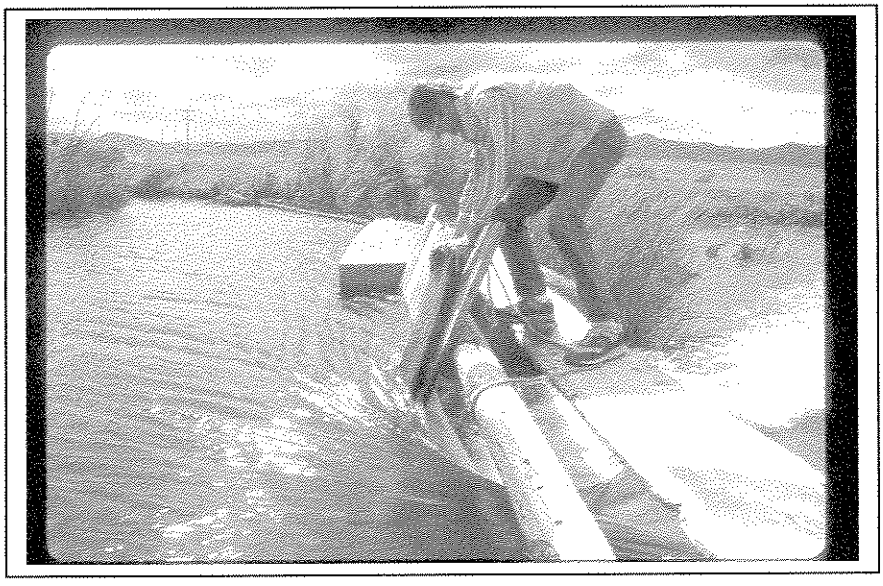
While waiting is in many ways more attractive to the irrigators, it puts far too much pressure on the CRMP Coordinator to make a decision, then try to relay and defend that decision to each of the potential participants in turn. Time is too short, and too much judgement and/or guessing is required.

This approach is (hopefully) now abandoned. The calendar day approach leaves open the option of cancellation should good conditions prevail, something that is far easier to do at the last minute.

Until salmon are ready (smolted), they are unlikely to leave the upper and middle sections of the Shasta. Rising water temperatures, combined with the passage of time contribute to the smoltification process. In order to be effective, we want to have an unimpaired flow in May after water temperatures have been at or near 74 degrees, hopefully giving salmonids a strong incentive to move. On average, this seems to have occurred by May 10, so unimpaired flows are scheduled shortly after that date. Water temperatures fluctuate during May, and can stay below for the whole month, or exceed 78 F (apparently lethal) before the end of the month. Any date set in advance can only hope to approximate proper timing to meet conditions of optimal effectiveness.

A second, smaller unimpaired flow is often also attempted in early June in an effort to target the last minute before water temperatures routinely exceed lethal limits for salmonids. This effort has been limited to water users starting with the Shasta Water Association, and those downstream of the Shasta Water Association in order to minimize encouraging fish likely to stay resident around Big Springs from moving from relatively safe areas into areas where water temperatures will rise too high. In most years it is extremely difficult for irrigators to miss two days of irrigation this far into the summer and we have only been able to do this when salmon numbers were critically low.

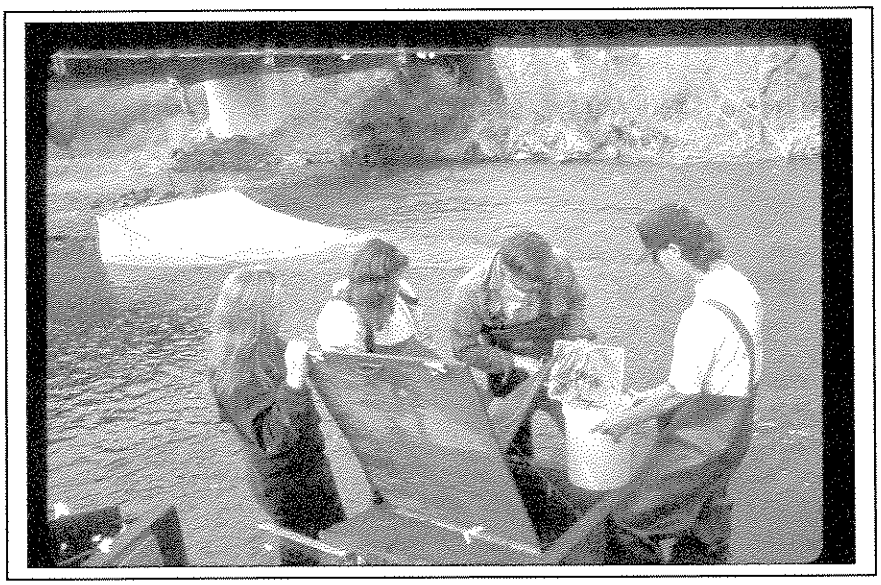
The unimpaired flow process itself is fairly simple. Water from the Montague Irrigation District Canal can be bypassed into the Shasta River channel just below Lake Shastina. Elsewhere, the various diversion dams consist of either vertical or horizontal flashboard dams, and one needs to slowly (over about a two hour period) remove those flashboards and allow the impounded water to be released. If pumps are present, they will need to be turned of before water levels drop below their intakes, and any ditches closed off.



Dave Webb, Shasta CRMP Coordinator, removing flashboards during unimpaired flow.

Flashboard dam removal proceeds downstream, with each succeeding dam being removed as the pulse of water from upstream just begins to reach it, there-by creating a prolonged pulse of stored water, followed by the natural unimpaired flow of the river.

During the first unimpaired flow there were concerns about stranding fish, and a large body of volunteers were utilized to search the shorelines of each impoundment, and also the Shasta Canyon looking for developing stranding problems, but none were found and subsequent efforts proceeded without additional monitoring for that problem.



Bill Chesney (with dip net) Cal. DFG, working with high school students from Yreka monitoring unimpaired flow with fyke net in background.

Removal of the all dams requires about 12 to 14 hours, and is started in the early morning hours between 4:00 and 7:00 am. Once all flashboards are removed, there is ample time to range the length of the river, observing conditions, monitoring flows, checking on outmigrant monitoring efforts, and observing water quality. As the end of the 48 hour period begins to approach, the flashboards need to be re-installed and the areas behind the dams re-filed with water. This process also proceeds from upstream to downstream, but with the flashboards installed in several separate batches at each site so that flows in the river drop slowly. At the end of the 48 hour process, all dams are in place and spilling and pumps can be turned on and ditches re-filled.

In order to buffer the resumption of irrigation, many of the independent water users will wait additional 12-24 hours so that the water that they would have diverted remains instream to ease the transition back to normal irrigation.

Monitoring of outmigrants is done as funds and volunteers allow, including before, during and after unimpaired flows. Monitoring efforts have used fyke net in early years, and more recently use of a rotary screw trap has been effective.

Results and discussion of accomplishments:

All meetings and discussions described above were made in 1998 to hold another unimpaired flow. As May Approached, it was apparent that the spring and early summer of 1998 were extremely unusual, with the highest volume of runoff on record. The Shasta River was out of its banks into June, and no flashboard dams were installed until mid-June. It was clear that there was nothing that would be accomplished with a pulsed flow so it was cancelled for that year.

In 1999 all preparations were again made, and again flows in the river were sufficient to make an unimpaired flow seem unlikely to make a significant improvement in salmonid survival, and it was again cancelled.

The same occurred in 2000.

In 2001, drought conditions returned to the Shasta Valley, and again preparations were made for an unimpaired flow. Participation was extremely difficult to secure because of the very long period without rainfall during the winter and spring. Never-the-less, we were able to secure enough participation to proceed.

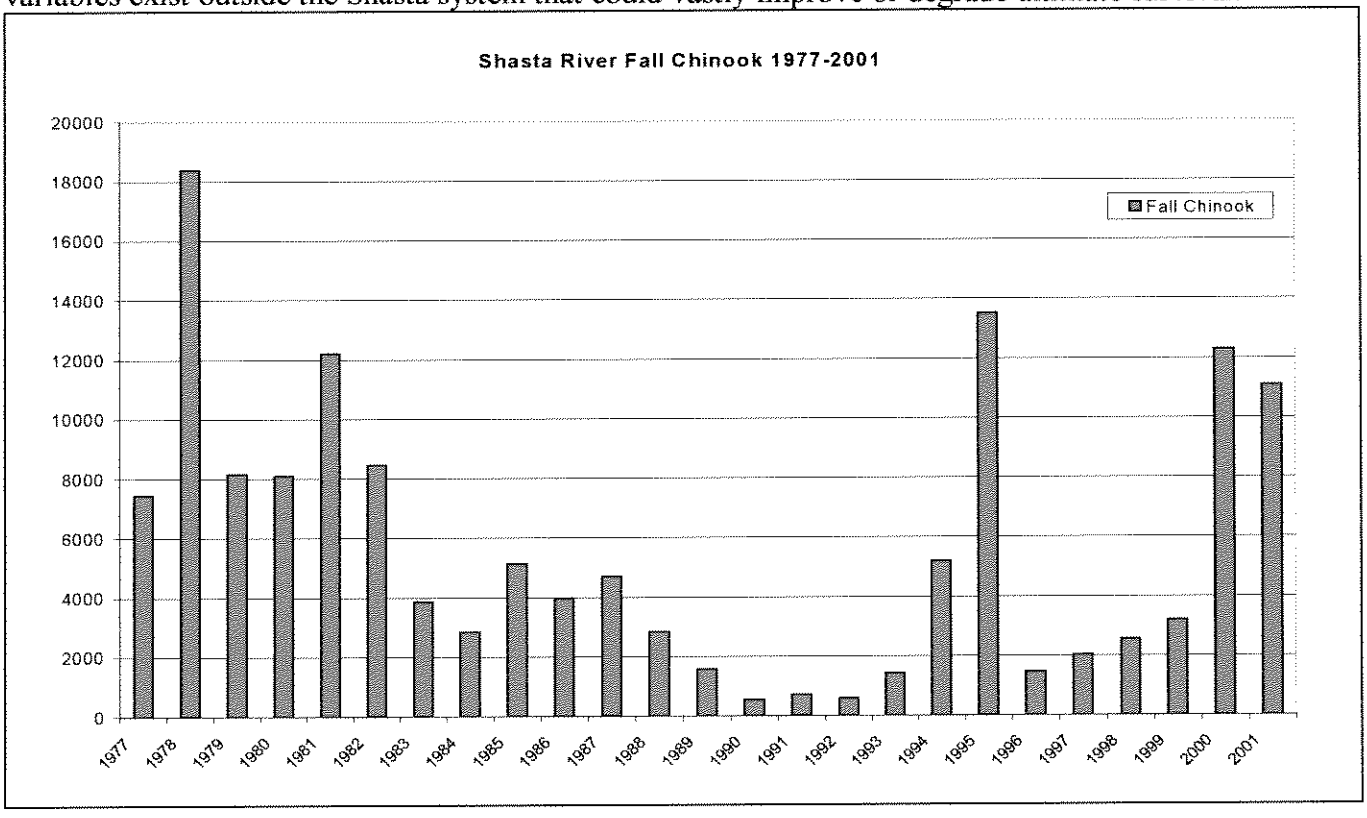
In 2002, dry conditions continued, making support for an unimpaired flow again difficult to secure. In addition, widespread anger at the pending state listing of coho made participation politically difficult for the irrigation districts. No unimpaired flow was done.

Summary and Conclusions:

The unimpaired flow is an unprecedented example of what is possible, even in a frequently difficult environment. In its early years it seems to have been one of the major factors that bumped fall Chinook spawner numbers from 520 to 13,000 from one generation to the next. As time has gone on, fall Chinook numbers have sustained themselves well above those low ebb years, removing much of the urgency associated with the early efforts. More recently, the focus has shifted to meeting the needs of coho salmon, and the unimpaired flows are being undertaken less frequently.

In all years, monitoring for success has been limited by available funding and equipment. Early monitoring with fyke nets worked well, but was extremely labor intensive, and as a result could not be sustained for long periods in order to establish baselines and determine outmigration patterns after each unimpaired flow. Screw trap monitoring, which has been ongoing for steelhead outmigrants, has been utilized since about 2000 and appears to be meeting many of the needs not met using fyke nets, but a longer baseline period of years will be necessary before any conclusions can be drawn with good data to support them.

Attempting to gauge success by counting spawner returns is likewise questionable, since so many variables exist outside the Shasta system that could vastly improve or degrade ultimate survival.



Spawner returns to Shasta River in recent years. First unimpaired flow occurred in 1993. Smolts assisted by that unimpaired flow returned as 3-year old adults in 1995.

The unimpaired flows are a tool that appear to have made a significant difference in fall Chinook survival, especially in their early years. At the start, the process was entirely experimental, with the unknown risk of doing more harm than good. Over time, it has matured to the point where there are seemingly no surprises left in the process. Current directions within the Shasta CRMP seem to be heading towards transferring responsibility for initiating unimpaired flows to the irrigation districts, then using CRMP staff to provide whatever on-the-ground support might be needed, once the major water users have decided to work together to undertake the effort in a given year.

Summary of Expenditures

Pulsed Flow Matching Funds

1. Multiple year CRMP membership meeting time devoted to pre- planning in February, March, April and May—1999, 2000, 2001, 2002. $1500
2. Multiple year irrigation district meeting time devoted to discussion and consideration of Pulsed Flow--1999, 2000, 2001, 2002. $6000
3. Time spent by other irrigators discussing and considering participation during 1999, 2000, 2001, 2002. $1200
4. Volunteer monitoring of Pulsed Flow in 2001—40 person hours @$25/hr=$1000
5. Monitoring Equipment provided by DFG—screw trap, lights, nets, etc. $500
6. Value of water forgone in 2001 @ $21/af.—Huesman ditch users 11 cfs for 48 hours, Novy and Rice Ranches, 6 cfs for 48 hours, Fiock, Himmel, & Spearin Ranches 10 cfs for 48 hours, other individual irrigators 10 cfs for 48 hours. $3108

Total match $13,308

U.S. Fish & Wildlife - P.O. Box 1006 - Yreka, CA 96097 3039
Irrigation Tailwater Direct costs-98-HP-04/1448-11333-98-J068

	Contract Budget	Monthly Expenses	Cumulative Expenses	Contract Balance
Salaries/Personnel	$1,750.00	$1,750.00	$1,750.00	$0.00
Annual Totals	$1,750.00	$1,750.00	$1,750.00	$0.00
Contract Totals	$1,750.00		$1,750.00	$0.00
BILLING AMOUNT		**$1,750.00**		